Refractive Contrast X-ray Imaging with Laboratory Sources

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Phase contrast imaging with laboratory sources provides a promising means of visualizing low atomic number materials that are difficult to image with conventional absorption-contrast imaging. The phase contrast in most non-periodic materials results almost solely from refraction in the object, and thus such imaging can be termed “refractive contrast imaging.” The authors will present models of several refraction contrast imaging techniques using both sources adapted to have long coherence lengths and imaging optics. Long coherence lengths can be achieved by using collimating optics to provide a parallel x-ray beam, or through the use of small sized sources and long source-object distances. The relative merits of these systems are discussed. Imaging optics allow refraction contrast imaging with lower coherence sources. A benefit of using imaging optics, such as compound refractive lenses or Fresnel zone plates, is that the required resolution on the x-ray camera is greatly reduced. Neither Talbot-Lau gratings nor analyzer crystals are used. Experimental data are presented for each technique, both to confirm the predicted performance, and to demonstrate their relative advantages and disadvantages.